



IEP NEWSLETTER

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Table 2 F_{ST} values for successive generations of the captive population of delta smelt and wild fish incorporated each generation (below diagonal). No pairwise comparisons were statistically significant, indicating little to no pairwise genetic differentiation between generations.

	Captive Population			Wild Fish Incorporated	
	F_0	F_1	F_2	Wild in F_1	Wild in F_2
F_0	0		NS	NS	NS
F_1	-0.01	0	NS	NS	NS
F_2	-0.01	-0.01	0	NS	NS
F_1 Wild	-0.03	-0.01	-0.03	0	NS
F_2 Wild	-0.01	-0.01	-0.04	0.00	0

* Significant ($P < 0.05$) differentiation is indicated with * (upper diagonal). NS = not significant.

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2010 Spring Kodiak Trawl Survey

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The 2010 Spring Kodiak Trawl (SKT) survey, conducted by the California Department of Fish and Game (DFG), ran from January 11 to May 6, 2010. The objective of the SKT is to determine the distribution of delta smelt (*Hypomesus transpacificus*) and provide water managers and fisheries regulators with information on areas of probable spawning. This information is of particular interest when the distribution of delta smelt favors the eastern or southern Delta, which can lead to increased entrainment loss of adults and juveniles. In addition to detecting distribution of adult delta smelt, the SKT survey also monitors the gonadal maturation of male and female delta smelt to determine the proportion of catch which is unripe, ripe, and spent. Macro-characteristics used for gonadal staging are described by R.C. Mager (personal communication, June 14, 2002) and are shown in Table 1.

Table 1 Macro-characteristics of male and female delta smelt gonads for the purpose of identifying maturity stage; adapted from R. C. Mager.

Stage	Male	Female
I	Left testis barely visible and right testis impossible to find.	Left ovary translucent and grainy in texture. Right ovary difficult to impossible to find.
II	Testis visible as thin strands ventrolateral to swim bladder.	Not differentiated from stage 1 for this study.
III	Left testis has developed in the central portion of the gonadal cord. Right testis visible as a thin pale white or gray cord.	Individual oocytes slightly orange, 0.25 – 0.50 mm in diameter, and visible to the naked eye.
IV	Both testis clearly visible, smooth, and pale white in color.	Abdomen is enlarged with egg mass and observable without dissection. Oocytes are bright orange and about 1 mm in diameter.
V	Testes are bright white and very smooth. Milt can be released with gentle pressure.	Oocytes are larger than 1 mm in diameter and hydrated. Clear fluid surrounds oocytes which become increasingly cloudy and degenerate.
VI	Testes and milt not as bright white as during stage V. Can be indicated by a decrease in size of testes.	Gonad is translucent and textured with a few leftover oocytes embedded in tissue. Loose abdomen is easily detected.

The SKT has employed Delta-wide surveys (numbered 1 – 5; Figure 1) each year and has often conducted supplemental surveys (numbered 11 – 15). Supplemental surveys are designed only to monitor the reproductive maturity of delta smelt and are conducted in areas of greatest delta smelt density as indicated by catch from preceding Delta-wide surveys. Beginning in 2008 and to reduce the take of delta smelt, only monthly Delta-wide surveys have been conducted.

Delta-wide surveys consist of at least 8 boat days and 160 man hours; 4 field staff use 2 boats to sample (trawl) once at 41 stations over ~ 4 days. Gear and gear-deployment methods are previously described by Souza (2002). Following field sampling, laboratory staff examine all delta smelt samples collected to assure accuracy of the gonadal staging process.

All fish caught were speciated and measured to the nearest millimeter fork length (FL). Sex and reproductive stage were recorded for all adult delta smelt. Sub-samples of delta smelt were preserved in ethanol (heads) and 10% buffered formalin (bodies), for later age, fecundity, and histopathology evaluations.

The 2010 SKT collected relatively few delta smelt (3rd lowest for the period of record, 2002 – 2010) during its 5 Delta-wide surveys, and followed the recent annual trend (except for 2009) of collecting ≤ 2 delta smelt per trawl (Figure 2). Total catch per survey was higher early in the year (Figure 3), which is expected from the annual life-cycle of delta smelt.

During Surveys 1 and 2, delta smelt distribution ranged broadly (Figures 4A and 4B), highest densities of delta smelt occurred in Montezuma Slough, and at least 73% of all delta smelt collected were located downstream of the confluence. During Surveys 3 and 4, at least 95% of all delta smelt were collected upstream of the confluence and peak densities occurred in Sacramento Deep Water Ship Channel (SDWC) (Figure 4C – 4D). During Survey 5, no delta smelt were collected downstream of the

confluence (Figure 4E). These distributions suggest an upstream migration for the purposes of spawning (based on female maturity results), with a majority of fish moving sometime between Survey 2 and Survey 3.

The female gonadal-stage distribution year was typical, as the fraction of ripe fish and spent fish increased (to a point) with water temperature (Figure 5). Ripe females were first detected during Survey 2, when water temperature (Figure 6) was just below the purported 12°C trigger/threshold needed to initiate spawning (Lindberg et al. 1997). Survey 3 yielded the first spent females of the year and coincided with an average water temperature of 12.1°C.

By adjusting catch to account for the frequency of temperature readings (so that more frequent readings per temperature group are not overrepresented), we found that roughly 68% of all pre-spawn females were collected at water temperatures $< 12^{\circ}\text{C}$, pre-spawn females were collected throughout the entire season's temperature range ($8.7^{\circ}\text{C} - 19.0^{\circ}\text{C}$; Figure 7), and greater than 87% of all ripe and spent females (adjusted catch) were collected at temperatures $\geq 12^{\circ}\text{C}$. We also found 98% of all delta smelt were collected at temperatures $< 16^{\circ}\text{C}$ (Figure 8) and that 60% were collected at conductance values of $< 1000 \mu\text{S}/\text{cm}$ (Figure 9).

The 2011 SKT field season is scheduled to begin in January 2011 and run through May 2011 using monthly surveys. Spring Kodiak Trawl data and the geographic distribution of delta smelt are available for viewing on our web page at <http://www.dfg.ca.gov/delta/projects.asp?ProjectID=SKT>.

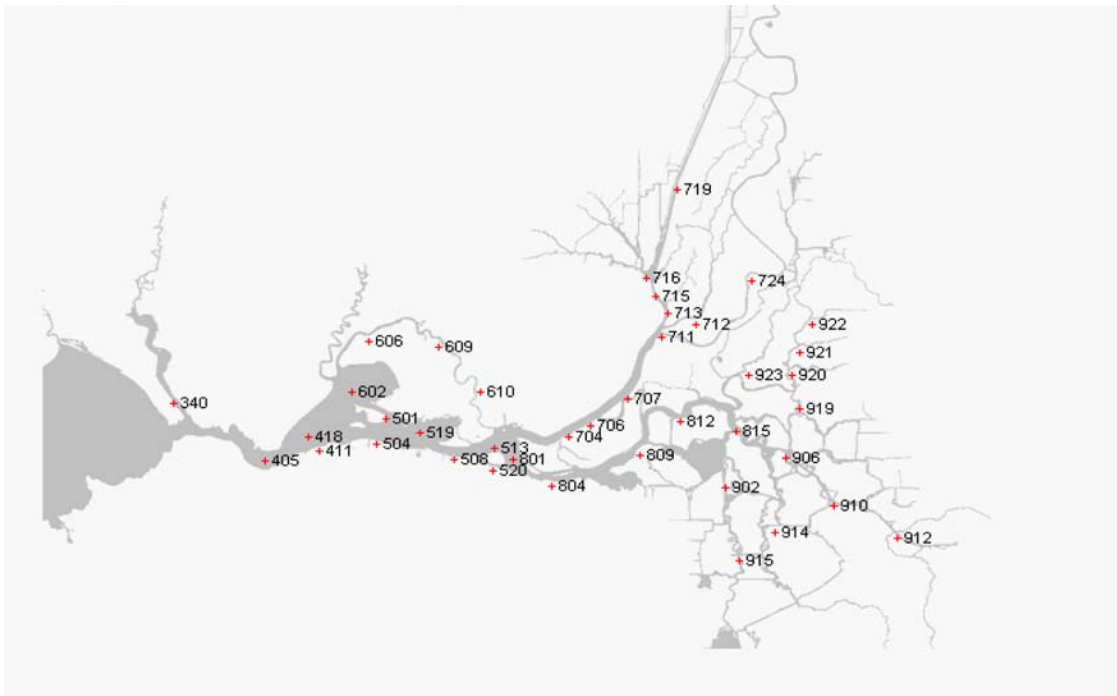


Figure 1 Current station locations sampled for the DFG Spring Kodiak Trawl Delta-wide survey.

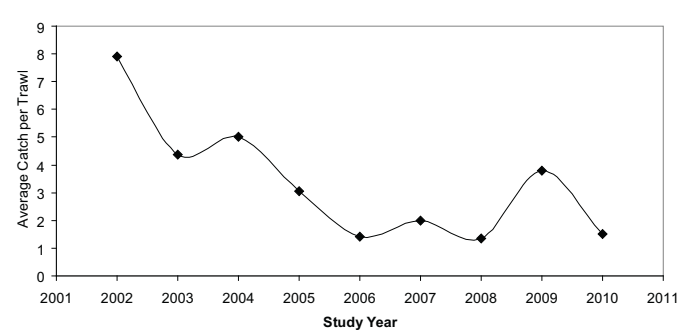


Figure 2 Summed annual delta smelt catch divided by the summed annual number of trawls from the DFG Spring Kodiak Trawl for the period of record: 2002 - 2010.

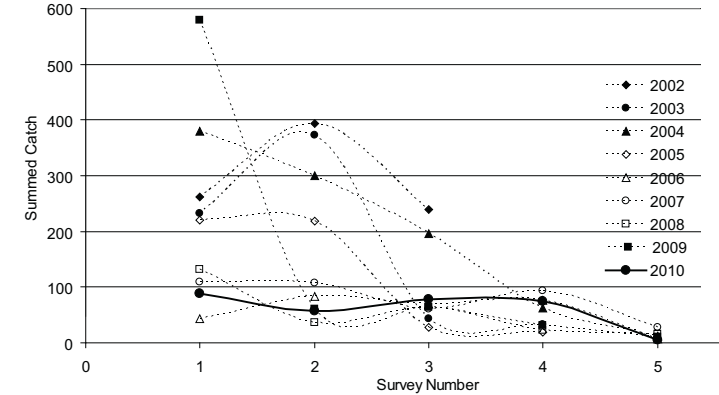


Figure 3 Summed catch of delta smelt by survey number of the DFG Spring Kodiak Trawl for the period of record: 2002 - 2010.

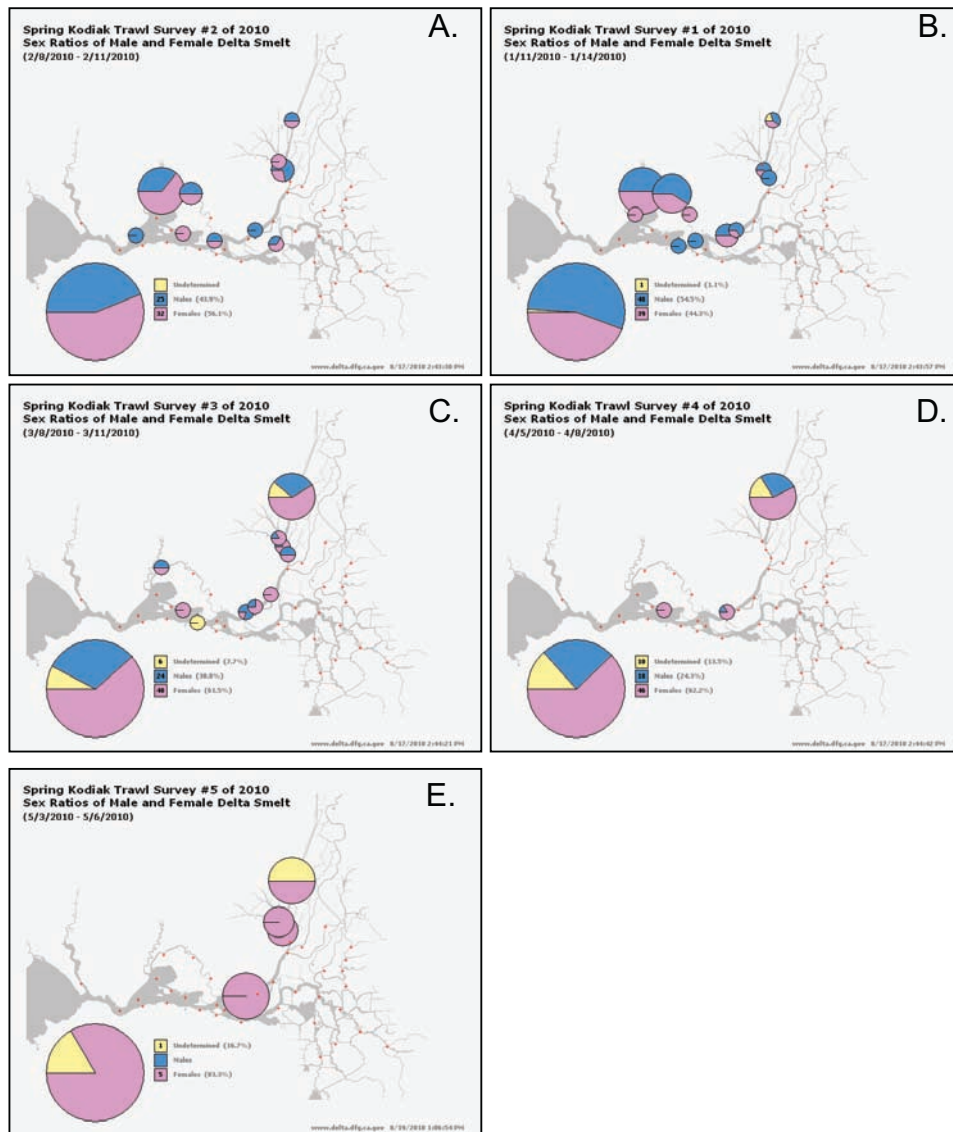


Figure 4 Geographical distribution of delta smelt by catch and by sex ratio for each 2010 Delta-wide survey, from the DFG Spring Kodiak Trawl web-page (<http://www.delta.dfg.ca.gov/data/projects/?ProjectID=SKT>).

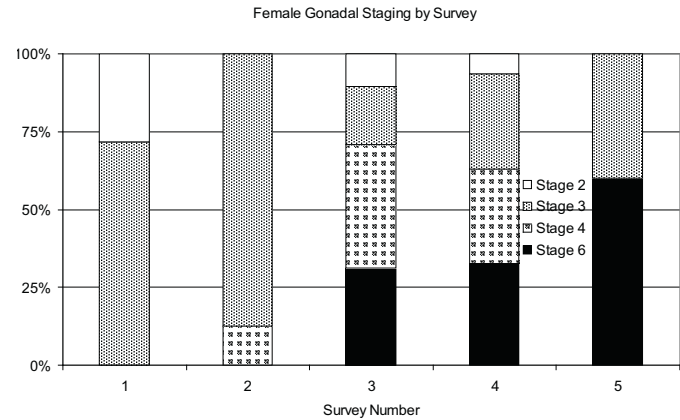


Figure 5 Gonadal-stage percent distribution of female delta smelt during each 2010 Delta-wide survey of the DFG Spring Kodiak Trawl. Stages 2 & 3 are pre-spawn, Stage 4 is ripe, and Stage 6 is spent.

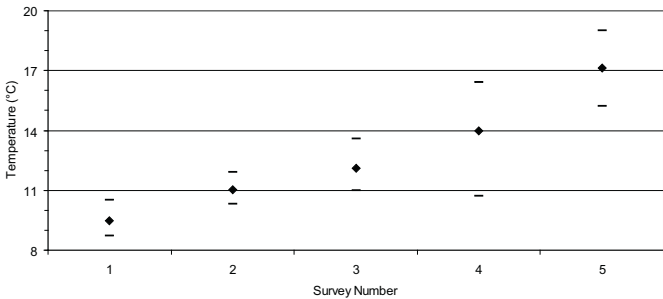


Figure 6 High, low, and average temperatures for each 2010 Delta-wide survey of the DFG's Spring Kodiak Trawl.

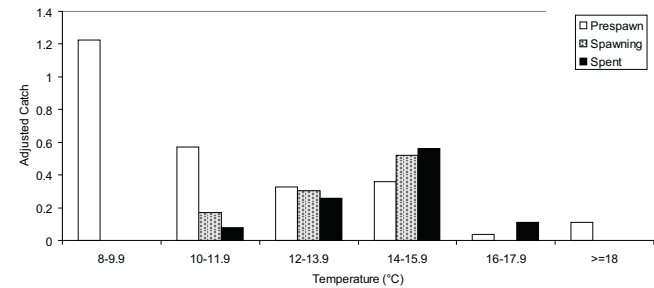


Figure 7 Temperature ranges in which female delta smelt were collected during the DFG Spring Kodiak Trawl 2010 field season. Female gonadal stages are broken down into pre-spawn, ripe, and spent groups.

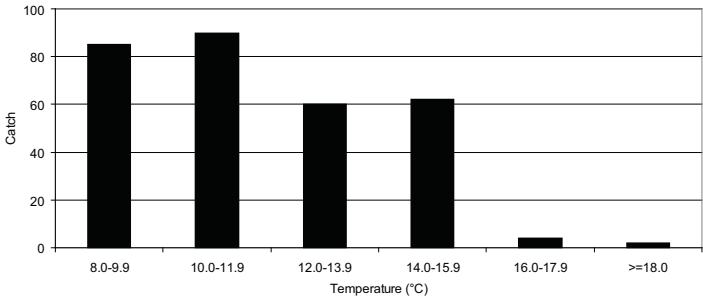


Figure 8 Temperature ranges in which delta smelt were collected during the DFG Spring Kodiak Trawl 2010 field season.

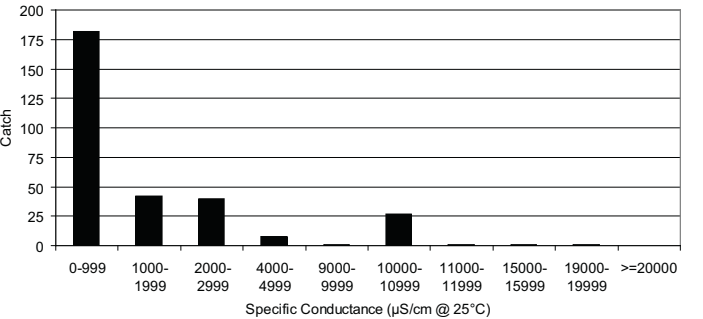


Figure 9 Specific conductance ranges in which delta smelt were collected during the DFG Spring Kodiak Trawl 2010 field season.

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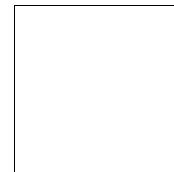
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■ Interagency Ecological Program for the San Francisco Estuary ■

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